TC Series Hydraulic Brake ABS System

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Eaton® Axle & Brake Service Manual, EB & ES Models, Publication number BRSM-0033: April 1997. © Eaton Corporation, 1997. All rights reserved.

Webb® Wheel Products, Inc. Installation, Service and Safety Instructions Manual, Publication number IM-298 (Supercedes IM-494).

Webb® Wheel Products, Inc. Torque Specifications, Publication number SD-012: Revised April, 1997.

Multiple loose-leaf instruction pages provided by Crewson Brunner®, Inc. on installing and maintaining Automatic Slack Adjusters, no publication number.

Holset® Air Compressor Field Service Manual, no publication number or date.

MGM Brakes Model TR – Tamper Resistant Spring Brakes, © MGM 12/92, Form Number 5026-MGM.

Midland™ EL1300 & EL1600 Air Compressor Service Procedures, Publication Number L30002, Rev. 9-93, © Midland-Grau Heavy Duty Systems.

Allied Signal Bendix® Brakes Air Brake Handbook, Components, Maintenance and Troubleshooting, © AlliedSignal T.B.S. Co. 9/1996, Publication number BW5057.

Allied Signal Bendix® Brakes TU-FLO 550 Compressor Service Data SD-01-333, © AlliedSignal 4/1996, Publication number BW1639.

Allied Signal Bendix® Brakes WS-20 Antilock Wheel Speed Sensor Service Data SD-13-4754, © AlliedSignal T.B.S. Co. 11/1996, Publication number BW1662.

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Brakes M-21 and M-22 Antilock Modulator Assembly Service Data SD-13-4793, © AlliedSignal T.B.S. Co. 11/1996, Publication number BW1664.

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Allied Signal Bendix® Brakes AD-9 Air Dryer Service Data SD-08-2412, © AlliedSignal T.B.S. Co. 5/1996, Publication number BW1627.

Allied Signal Bendix® Brakes Push-Pull Type Control Valves Service Data SD-03-3611, © AlliedSignal T.B.S. Co. 4/1996, Publication number BW1578.

Allied Signal Bendix® Brakes E-6 & E-10 Dual Brake Valves Service Data SD-03-817, © AlliedSignal 6/1996, Publication number BW1427.

Allied Signal Bendix® Brakes R-12 & R-14 Relay Valves Service Data SD-03-1064, © AlliedSignal 6/1996, Publication number BW1431.

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Safety

The purpose of this safety summary is to ensure the safety and health of personnel and the protection of equipment.

All users of this publication shall read, understand, and apply this safety summary when performing maintenance and operating procedures.

WARNINGS and Cautions

All users of this publication shall read, and understand, all WARNINGS and Cautions.

WARNING

WARNINGS REFER TO A PROCEDURE OR PRACTICE THAT, IF NOT ADHERED TO, COULD RESULT IN INJURY OR DEATH.

Caution

Cautions refer to a procedure or practice, that, if not adhered to, could result in damage to or destruction of equipment.

Introduction

This supplement contains information for the Meritor Version D hydraulic ABS.

Meritor Wabco™ hydraulic anti-lock braking system (ABS) is an electronic wheel speed monitoring and control system. Meritor Wabco™ hydraulic anti-lock braking system (ABS) is used on buses and is chassis equipped with a hydraulic brake system.

Description of Operation

Wheel sensors detect wheel speed. The sensors generate signals that are transmitted to an Electronic Control Unit (ECU). If the wheels start lockup, the ECU sends a signal to the modulator assembly to regulate the brake pressure of each the affected wheel.

During an ABS stop, a solenoid valve in the modulator assembly is rapidly pulsed; that is, it opens and closes several times per second to control the brake pressure. When this occurs, drivers may notice a pulsation on the brake pedal.

An ABS indicator lamp on the vehicle dash alerts the driver to a possible system fault and provides blink code information to diagnose the system.

If the ABS indicator lamp comes on during normal vehicle operation, drivers may complete the trip, but are instructed to have the vehicle serviced as soon as possible.

In the unlikely event of an ABS system malfunction, the ABS of the affected wheel will be disabled and will return to normal braking. The other sensed wheels will retain their ABS function.

Electronic Control Unit (ECU) Identification

Note

Do not open the ECU. Opening the ECU to gain access to the internal components will void the warranty.

To determine the hydraulic ABS version installed on the vehicle by looking at the ECU. D version has three (3) connectors, see Figure 1—Version C and D ECU.

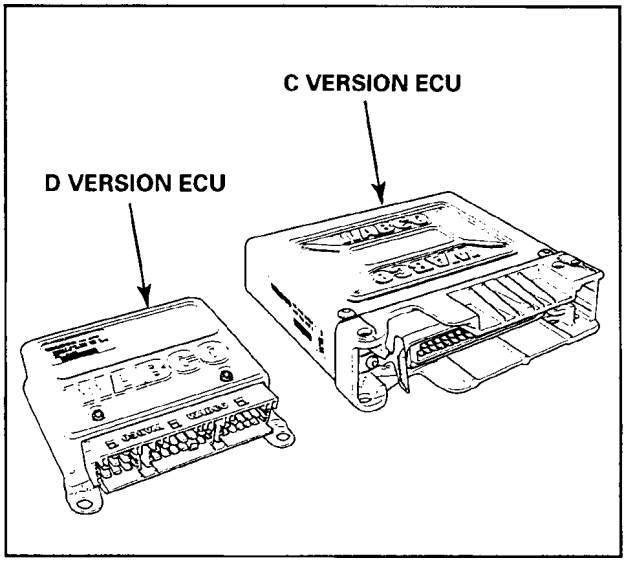


Figure 1—Version C and D ECU

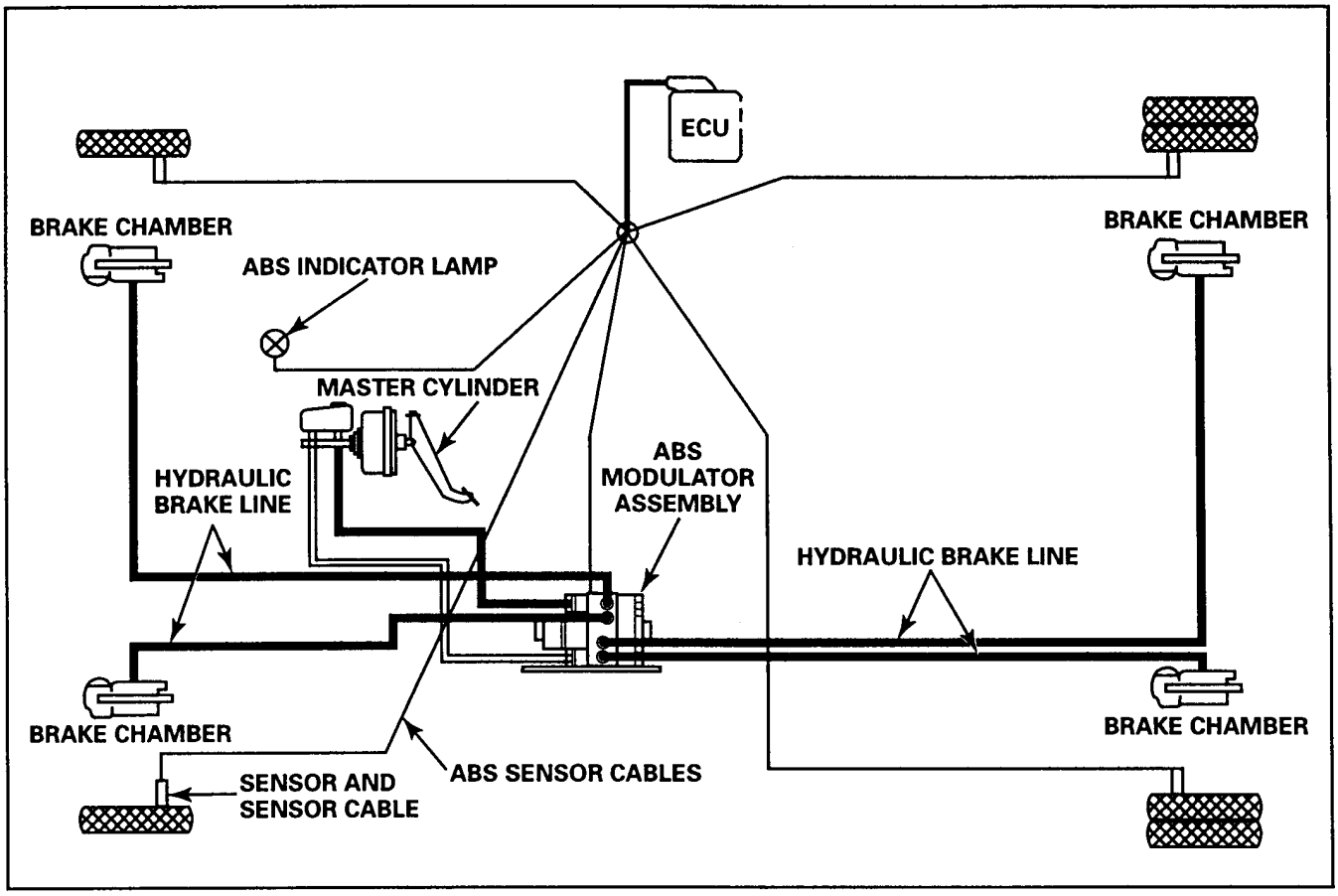


Figure 1.2—A Typical Meritor WABCO Hydraulic ABS System

System Components

The following components are the Meritor WABCO Hydraulic ABS:

- Electronic Control Unit, see Figure 1.3—Electronic Control Unit

1. Processes sensor signals and generates solenoid valve commands to reduce maintain or reapply brake pressure.
2. Mounting locations vary, depending on the vehicle specifications for the exact location.

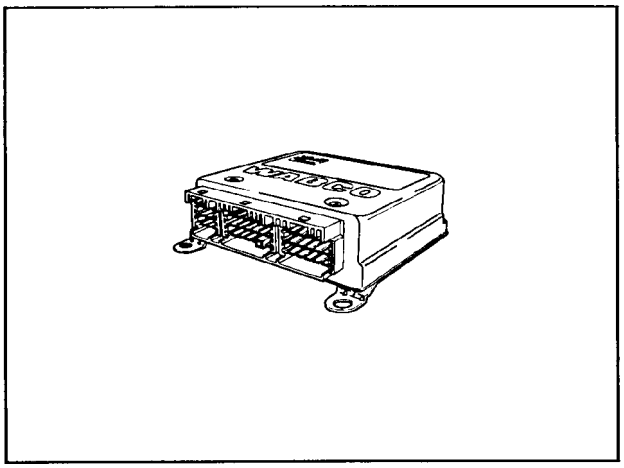


Figure 1.3—Electronic Control Unit

- Modulator Assembly, see Figure 1.4—Modulator Assembly

3. Houses the ABS solenoid control valves, (one inlet valve and one outlet valve per wheel), a pump motor and two (2) accumulators.

Caution

Modulator should not be exposed to impact loads, excessive vibrations or compressed air blown into the hydraulic ports.

WARNING

BRAKE FLUID IS FLAMMABLE AND TOXIC TO SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION IS REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. DRAIN FLUID IN A WELL-VENTILATED AREA.

4. Sensors contain brake fluid and must be handled with appropriate care.

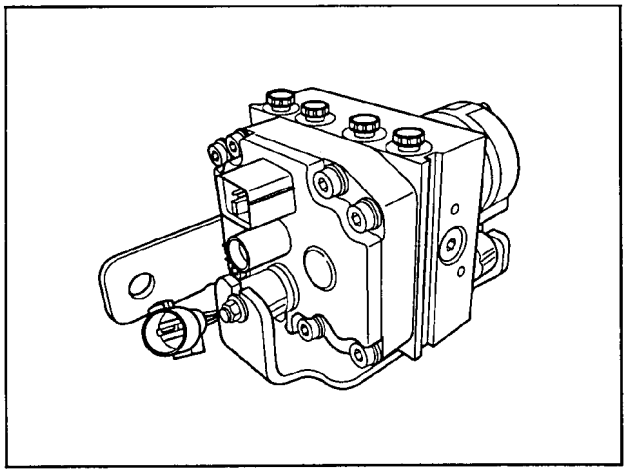


Figure 1.4—Modulator Assembly

- Sensor with Molded Socket, see Figure 1.5—Molded Socket

5. Measures the speed of a tooth wheel rotating with the vehicle wheel.
6. Produces an output voltage proportional to wheel speed.

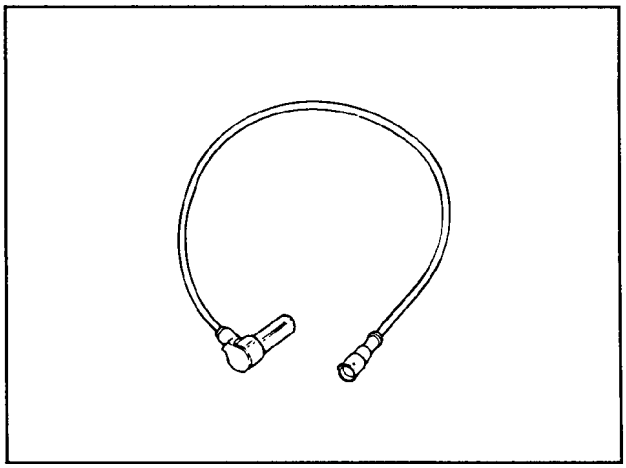


Figure 1.5—Sensor with Molded Socket

- Sensor Spring Clip, see Figure 1.6—Sensor Spring Clip.
- Holds the wheel speed sensor in close proximity to the tooth wheel.

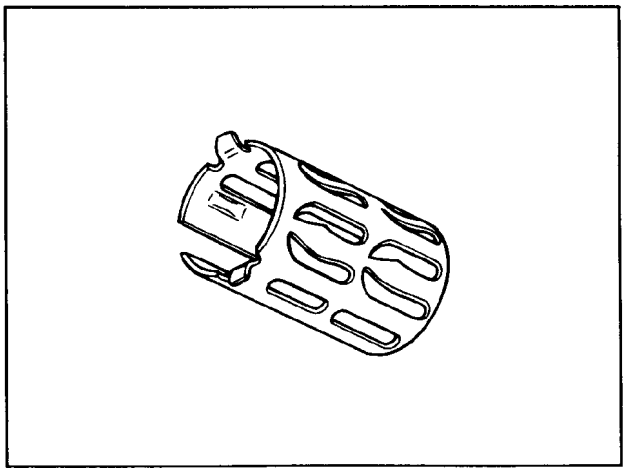


Figure 1.6—Sensor Spring Clip

- Tooth Wheel, see Figure 1.7—Tooth Wheel
- A machined or stamped ring mounted to a machine surface on the hub of each ABS-monitored wheel.

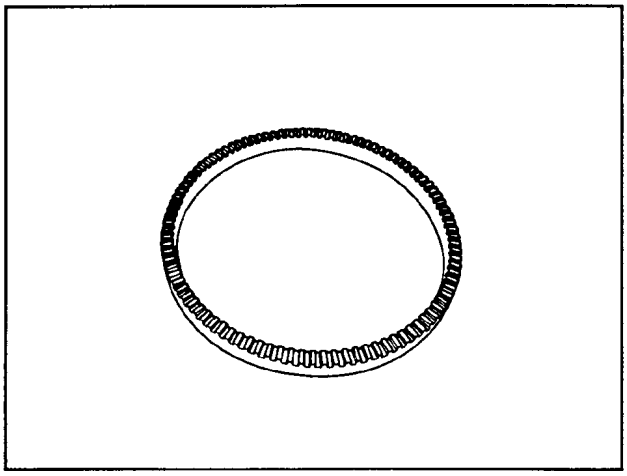


Figure 1.7—Tooth Wheel

- Sensor Extension Cables, see Figure 1.8—Sensor Extension Cables

7. Two-wire cable with molded-on connector.
8. Connector the wheel speed sensor to the ECU.

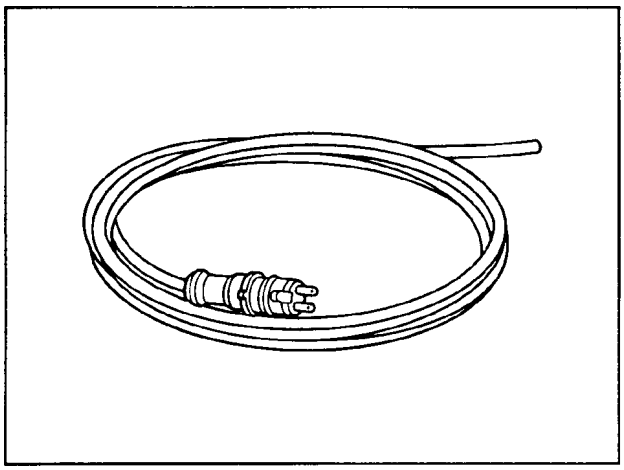


Figure 1.8—Sensor Extension Cables

- ABS Indicator, see Figure 1.9—ABS Indicator

9. Located on vehicle dash.
10. Alerts driver to a possible system fault.
11. Used by service personnel to display blink codes.
12. Meritor WABCO does not provide ABS indicator lamp.

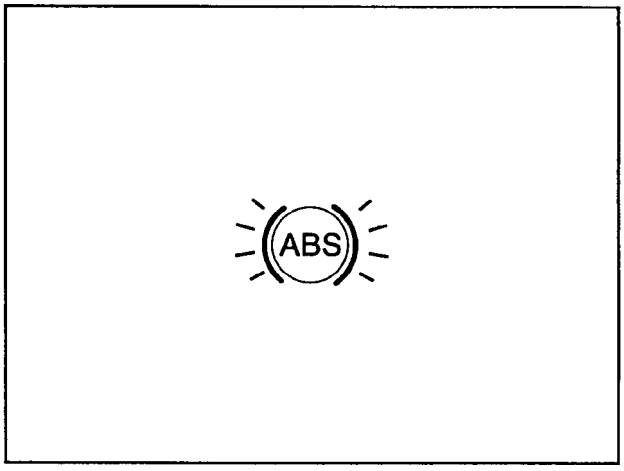


Figure 1.9—ABS Indicator

Component Removal and Installation

Sensors

- Sensor Lubrication Specification

Meritor WABCO specifications require a sensor lubricant to have the following properties.

1. Lube must be mineral oil-based and contain molydisulfide.
2. Lube should have excellent anti-corrosion and adhesion properties, and be capable of continuous function in a temperature range of
3. –40° to +300° Fahrenheit.

Wheel Speed Sensor Replacement – Front Axle

Removal

WARNING

CHOCK THE WHEELS TO PREVENT THE VEHICLE FROM MOVING. SUPPORT THE VEHICLE WITH SAFETY STANDS. DO NOT WORK UNDER A VEHICLE SUPPORTED ONLY BY JACKS.

WARNING

TO AVOID DAMAGE TO THE ELECTRICAL SYSTEM OR ABS COMPONENTS, WHEN WELDING ON AN ABS-EQUIPPED VEHICLE DISCONNECT THE POWER CONNECTOR FROM THE ECU.

1. Apply the parking brakes. Chock the rear tires to prevent vehicle movement.
2. Disconnect the fasteners that hold the sensor cable to other components.
3. Disconnect the sensor cable from the chassis harness.
4. Remove the sensor from the sensor holder.
5. Twist and pull the sensor to remove from the sensor bracket, see Figure 2—Knuckle Mounted Sensor.

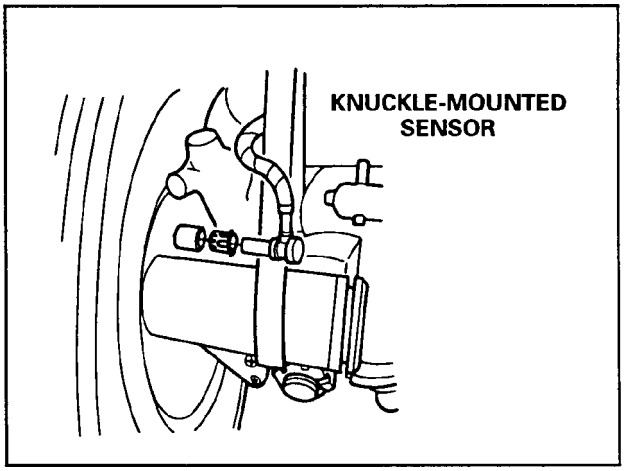


Figure 2—Knuckle Mounted Sensor

Knuckle Mounted Sensor Installation

1. Connect the sensor cable to the chassis harness.
2. Install the fasteners used to hold the sensor cable in place.
3. Apply a Meritor WABCO recommended lubricant to the sensor spring clip and sensor.
4. Install the sensor spring. Make sure the spring clip tabs are on the inboard side of the vehicle.
5. Push the sensor spring clip into the bushing in the steering knuckle until the clip stops.
6. Push the sensor completely into the sensor spring clip until clip contacts the tooth wheel.
7. Fasten the sensor cable with tie wraps every 12 inches. Properly bundle and store excess cable in the sub frame, see Figure 2.1—Bundle Excess Cable.

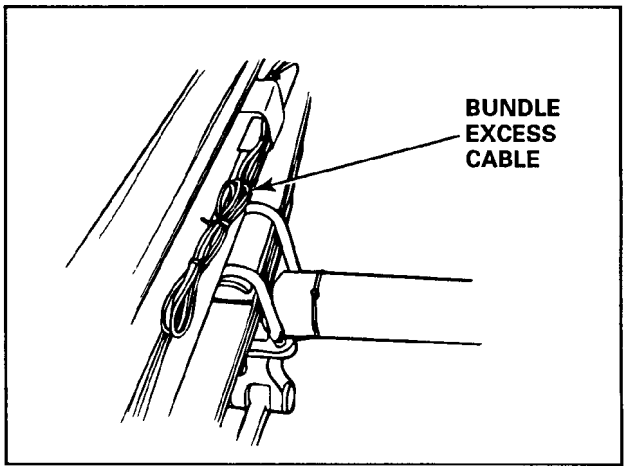


Figure 2.1—Bundle Excess Cable

8. Replace tire and drum if required. Remove safety stands, lower the vehicle, and remove the chocks from front tires.
9. Perform a voltage output check to ensure proper installation, refer to Sensor Output Voltage Test in troubleshooting section.

Modulator Assembly

Modulator Assembly Removal

WARNING

BRAKE FLUID IS FLAMMABLE AND TOXIC TO SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION IS REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. DRAIN FLUID IN A WELL-VENTILATED AREA.

1. Apply the parking brakes. Chock the front and rear tires to prevent vehicle movement.
2. Place a container under the modulator assembly to catch brake fluid.
3. Disconnect the electrical harness connector from the modulator assembly.
4. Mark the six brake lines for ease of installation.
5. Disconnect the lines from the modulator assembly.

Caution

Whenever any hydraulic system fitting is loosened or disconnected, the entire system must be bled to remove any air.

6. Remove three (3) mounting capscrews, washers, and nuts that attach the modulator assembly and bracket assembly to vehicle.

Modulator Assembly Installation

1. Position the modulator assembly and bracket in place on the vehicle, see Figure 2.2—Modulator Position.

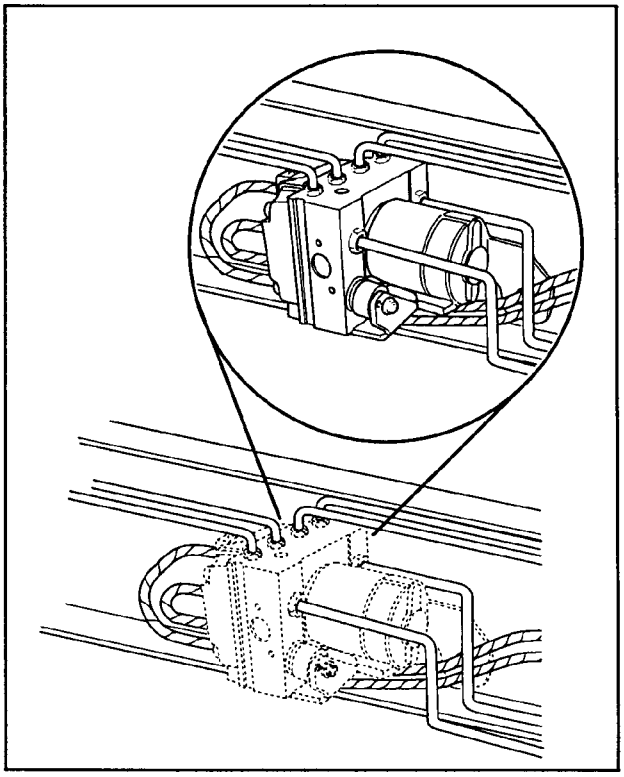


Figure 2.2—Modulator Position

2. Torque three (3) mounting nuts to 132 inch-pounds.
3. Connect and torque two (2) small brake line adapters to 108 inch-pounds.
4. Connect and torque four (40) large brake line adapters to 132 inch-pounds.

WARNING

FAILURE TO BLEED THE SYSTEM WHENEVER ANY HYDRAULIC SYSTEM FITTING IS LOOSENED OR DISCONNECTED WILL ALLOW AIR TO REMAIN IN THE BRAKE SYSTEM. THIS WILL CAUSE THE STOPPING DISTANCE TO INCREASE AND CAN RESULT IN SERIOUS INJURY.

PROPERLY DISCARD HYDRAULIC FLUID THAT IS REMOVED FROM THE BRAKE SYSTEM. HYDRAULIC FLUID THAT IS COMTAMINATED CAN CAUSE DAMAGE, LOSS OF BRAKING AND SERIOUS INJURY.

WARNING

DO NOT USE OR MIX DIFFERENT TYPES OF HYDRAULIC FLUID. THE WRONG HYDRAULIC FLUID WILL DAMAGE THE RUBBER PARTS OF THE BRAKE CALIPER AND CAN CAUSE DAMAGE, LOSS OF BRAKING AND SERIOUS INJURY.

Caution

Do not allow brake fluid to touch any painted surfaces, as it will remove the paint. Brake fluid may also damage certain non-metal surfaces. Do not allow fluid to get on brake pads, shoes, rotors, or drums.

Hydraulic ABS System Bleeding Procedure

This procedure specifies how to bleed the hydraulic ABS modulator in case of unwanted air in the modulator and/or suction area of the pump system.

The ignition must remain off throughout the duration of the manual bleeding of the system, energizing of the unit during bleeding, unless specified.

Note

During bleeding procedure, reservoir fluid is not permitted to fall below the **MIN** level. Observe the level regularly and replenish if necessary to the **MAX** level marked on the reservoir.

1. Required bleed and fill equipment
   - Clean glass or plastic bottle/receptacle
   - Rubber/plastic bleed hose
   - Suitable bleed spanner
   - Manufacturer's recommended brake fluid, approximately ½ gallon
   - Electronic controller or manual modulator actuator
2. Master Cylinder Filling and Bleeding
   - Replenish reservoir with the specified brake fluid.
   - Depress braking pedal 5 times in 5 seconds using only the stroke between 1/3 of maximum value.
   - Release the pedal for 5 to 10 seconds Air bubbles will rise into the reservoir.
   - Repeat all these steps 3 times until sufficient resistance is felt at the pedal.
3. Brake Circuit Bleeding
   - Fit bleed hose onto one of the bleed screw nipple.
   - Submerge free end of bleed hose into the brake fluid of the bleed bottle.
   - Actuate the brake pedal several times then depress and hold firm.
   - Open the bleed screw of the longest brake circuit to be bled, often with the RR
   - Allow fluid to flow until no air bubbles or fluid flows into the bleed bottle.
   - Close the bleed screw prior to the final release of the brake pedal.
   - Repeat step 3 until fluid flows without any air bubbles.
   - Repeat step 3 on other three brakes, in order of longest to shortest circuit from the modulator, Rl, FR, and FL.
4. Modulator Pump System Filling and Bleeding
   - Pulse the inlet and outlet solenoids of brake circuit being bled and activate the pump motor using the ABS switch box. Start with the longest brake circuit, typically the right rear.
   - Perform conventional bleeding procedure, section 3, while activating solenoids and pump motor for all brake circuit.
   - Repeat steps in section 4 until no air is present, typical four times.

Manual Bleeding

WARNING

BRAKE FLUID IS FLAMMABLE AND TOXIC TO SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION IS REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. DRAIN FLUID IN A WELL-VENTILATED AREA.

Caution

Do not let the brake master cylinder fluid level get too low during the bleeding operation.

1. Apply the parking brake and chock the wheels.
2. Bleed the master cylinder, see Figure 2.3—Rear Bleeding Location.

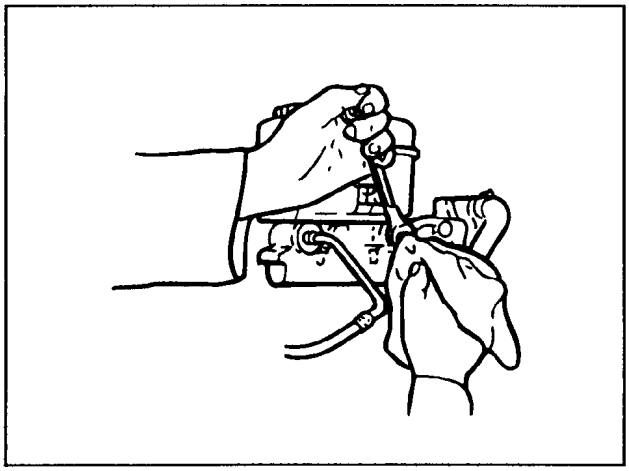


Figure 2.3—Rear Bleeding Location

3. Loosen the fitting at the rear outlet port on the master cylinder until the fluid begins to flow.
4. Push the brake pedal down slowly until the pedal reaches the floor. Brake fluid and any air in the master cylinder will discharge through the fitting.

Caution

Do not release the brake pedal until the fitting has been tightened. Failure to do so will allow air bake into the system.

5. Press the brake pedal down, hand tighten the rear hydraulic line fitting.
6. Release the brake pedal.
7. Loosen fitting again and repeat steps 1 through 6.
8. Move to the front master cylinder and repeat all steps 1 through 9, see Figure 2.4—Front Bleeding Location.

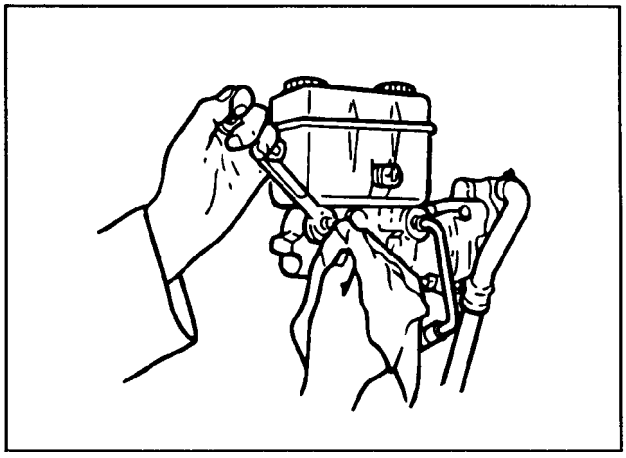


Figure 2.4—Front Bleeding Location

9. Repeat all steps for left rear, right front, and left front brakes.
10. Recheck all fluid levels and test drive vehicle for stopping distance and brake pedal pressure.

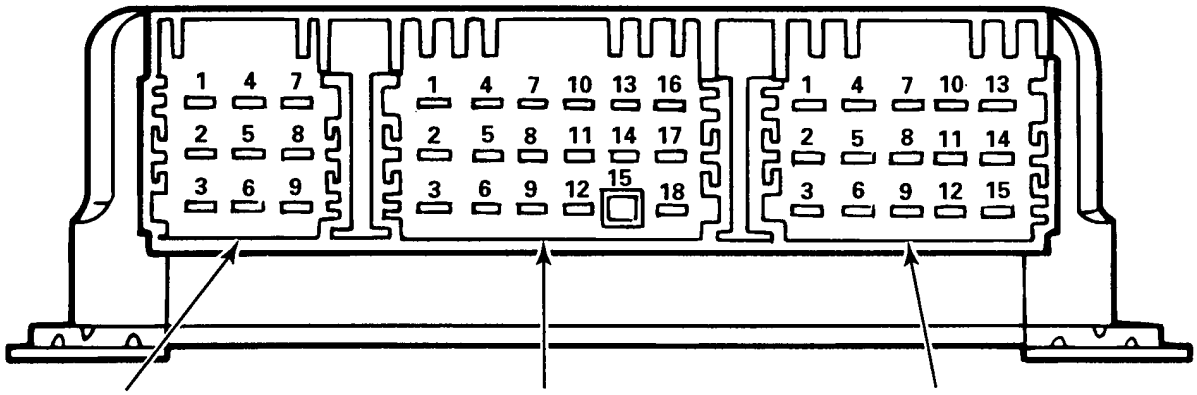
Troubleshooting and Testing

General Maintenance Information

There is no regularly schedule maintenance required for Meritor WABCO D version hydraulic ABS other than checking the fluid level.

Wiring may vary, according to the vehicle. Refer to the vehicle specifications for specific wiring diagrams. For a typical Meritor WABCO 4S/4M hydraulic ABS diagram, see Table 1—Pin Numbers and Locations.

Pin Numbers and Locations



9-Pin ECU Connector

Pin Number	Circuit Description
1	Left Front Sensor
2	Left Front Sensor
3	Right Rear Sensor
4	Right Front Sensor
5	Right Front Sensor
6	Right Rear Sensor
7	Left Rear Sensor
8	Left Rear Sensor
9	Not Used

18-Pin ECU Connector

Pin Number	Circuit Description
1	+12 Battery
2	+12 Ignition
3	Not Used
4	Not Used
5	SAE J1587 (-)
6	SAE J1587 (+)
7	Not Used
8	Motor Monitor
9	Not Used
10	Not Used
11	Not Used
12	Ground
13	Not Used
14	Not Used
15	Jumper
16	Not Used
17	Not Used
18	ABS Indicator Lamp

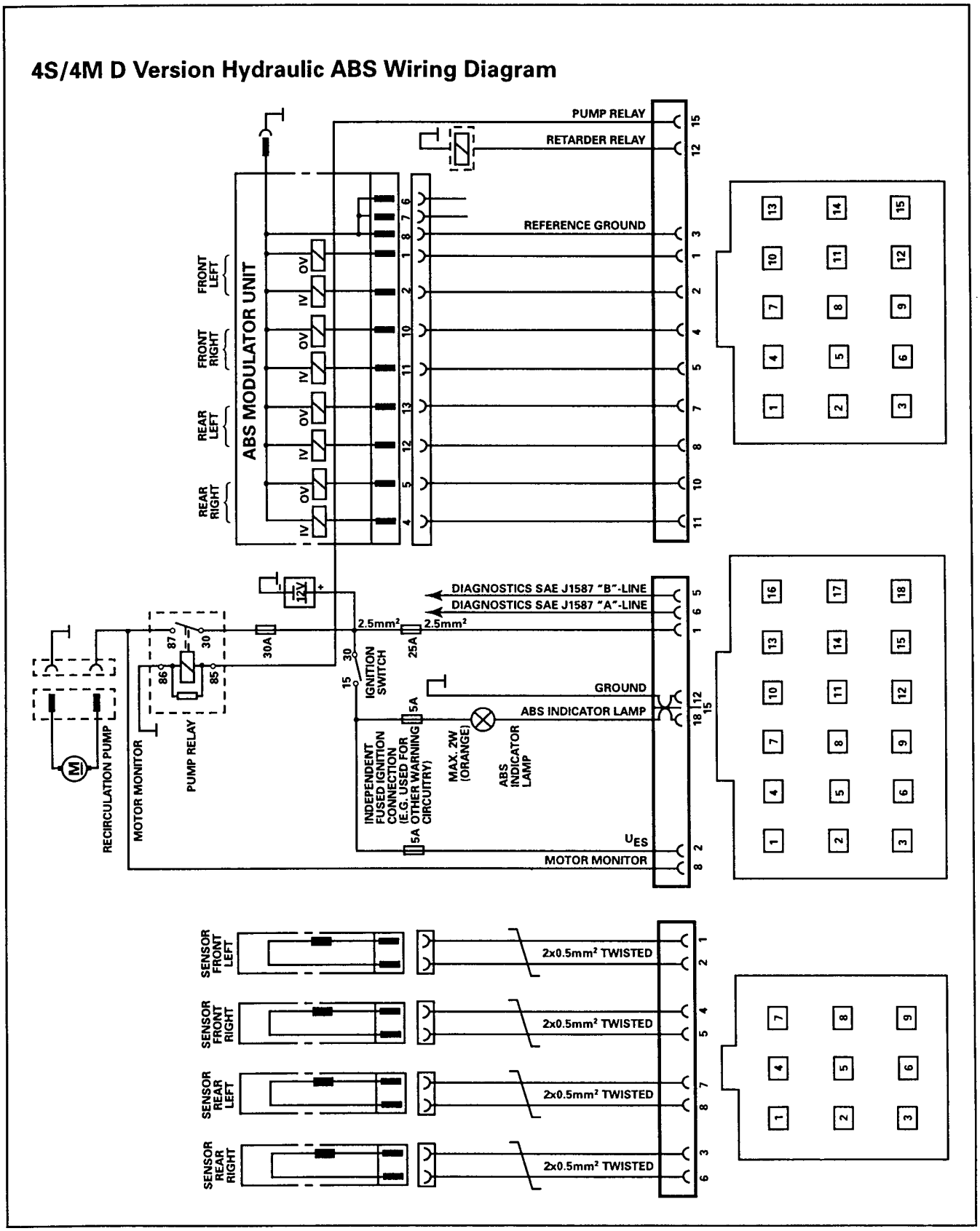
15-Pin ECU Connector

Pin Number	Circuit Description
1	Left Front Outlet Valve
2	Left Front Inlet Valve
3	Ground
4	Right Front Outlet Valve
5	Right Front Inlet Valve
6	Not Used
7	Left Rear Outlet Valve
8	Left Rear Inlet Valve
9	Not Used
10	Right Rear Outlet Valve
11	Right Rear Outlet Valve
12	Retarder
13	Not Used
14	Not Used
15	Pump Relay

Figure 3—Pin Numbers and Locations

9-Pin ECU Connector		18-Pin ECU Connector		15-Pin ECU Connector	
Pin Number	**Circuit Description**	**Pin Number**	**Circuit Description**	**Pin Number**	**Circuit Description**
1	Left Front Sensor	1	+ 12 Battery	1	Left Front Outlet Valve
2	Left Front Sensor	2	+ 12 Ignition	2	Left Front Inlet Valve
3	Right Rear Sensor	3	Not Used	3	Ground
4	Right Front Sensor	4	Not Used	4	Right Front Outlet Valve
5	Right Front Sensor	5	SAE J1587 (-)	5	Right Front Inlet Valve
6	Right Rear Sensor	6	SAE J1587 (+)	6	Not Used
7	Left Rear Sensor	7	Not Used	7	Left Rear Outlet Valve
8	Left Rear Sensor	8	Motor Monitor	8	Left Rear Inlet Valve
9	Not Used	9	Not Used	9	Not Used
---	---	10	Not Used	10	Right Rear Outlet Valve
---	---	11	Not Used	11	Right Rear Inlet Valve
---	---	12	Ground	12	Retarder
---	---	13	Not Used	13	Not Used
---	---	14	Not Used	14	Not Used
---	---	15	Jumper	15	Pump Relay
---	---	16	Not Used	---	---
---	---	17	Not Used	---	---
---	---	18	ABS Indicator Lamp	---	---

Table 1—Pin Numbers and Location



Schematic 1—4S/4M D Version Hydraulic ABS Wiring Diagram

Blink Code Diagnostics

- ABS Indicator Lamp

This lamp, located on the vehicle dash, serves two purposes:

1. Alerts drivers or service personnel to a possible fault in the hydraulic ABS, as follows:

- If the ABS indicator lamp comes on briefly then goes to off when the ignition is turned on, there are no active or stored faults in the hydraulic ABS.
- If the ABS indicator lamp comes on and stays on after the ignition is turned on and the vehicle is driven in excess of 4 mph, there may be an active fault in the hydraulic ABS.
- If ABS indicator lamp comes on and stays on and Goes off after the vehicle is driven more than 4 mph there may be a stored fault in the hydraulic ABS.
- Displays diagnostic blink codes for servicing.

Definitions

- Blink Code:

A series of blinks or flashes that describe a particular ABS system condition.

- Blink Code Diagnostics:

The ability of the Meritor WABCO ECU to sense faults in the ABS system and to define these faults using blink codes.

- Blink Code Switch:

A momentary switch that activates blink code diagnostic capabilities. Usually, it is mounted under the dash or on the steering column.

- Clearing Fault Codes:

The process of erasing faults from the ECU memory bank.

- Fault Code:

An ABS condition (fault) detected and stored in memory by the Meritor WABCO ECU and displayed by blink code. System faults may be Active or Stored.

- Active Fault:

A condition that currently exists in the ABS system; for example, a sensor circuit malfunction on the left front steering axle. An active fault must be repaired before additional faults can be displayed. When an active fault has been repaired, it becomes a stored fault.

- Stored Fault:

A condition that caused the system to register a fault but is not currently active. For example, a loose wire that corrected itself. A stored fault can also be an active fault that has been corrected.

- Table 2 describes the method of distinguishing between active and stored faults and explains how to clear them.

Using Blink Code Diagnostics

- Observe the steps in Table 2—Identifying D Version Hydraulic ABS Blink Codes.

Note

If you receive a blink code that is not identified in Table 2, contact the Meritor Customer Support center at (800) 535-5560.

	Response	Status	Action
Step 1 Turn ignition key **on** **Do not** turn engine on. Press Blink Code Switch once, then release.	ABS indicator lamp Does not come on	Loose or burned Out bulb Voltage not within acceptable range (9.5 to 14 volts)	Repair or replace lamp bulb. Measure voltage, check connections. Make necessary repairs.
	ABS indictor lamp comes on briefly then goes out.	➔	Check ABS indicator lamp for blink code.
	IF 1-1 blink code is displayed	System **Okay**	No further action required.
	IF one blink code-other than 1-1—is continuously displayed.	System fault exists	Go to step 2.
	IF a series of codes are displayed	Stored faults in system	Go to step 3.
Step 2 Repair fault	➔	➔	Find blink code on Table 3 Turn ignition switch off Repair fault Clear the fault (go to step 3)
Step 3 Clear fault Turn ignition key **on**. **Do not** turn engine on. Press blink code switch. **Hold for 3 seconds**. Release.	ABS indicator lamp displays blink code 1-1, goes **off** If the ABS indicator lamp displays blink code 1-1, goes **off**, then comes back on, and stays **on**.	System **Okay** System looking for wheel speed. This occurs after a sensor fault.	No further action required. Drive the vehicle at a speed of 4 mph. Once the ECU senses wheel speed, the lamp will go **off**.

Table 2—Identifying D Version Hydraulic ABS Blink Codes

Using Blink Code Diagnostics (continued)

Use the information in Table 3 to identify a fault, check for proper volt or ohm measurements, and repair the fault.

1. Identify and record the blink code. Blink codes are identified in columns 1 and 2.
2. Test the pins indicated. Pin locations to be tested are listed in column 3.
3. Compare the measurement received against the correct volt or ohm measurement listed in column 4.
4. Observe the instructions listed in column 5.

Note

Abbreviations IV are Inlet Valve and OV is Outlet Valve.

Ignition Key On to determine ABS blink code fault		Ignition Key off to test system (except where noted)			
1 Fault Code	**2** Problem Area	**3** **Connector**	**Pins to be Tested**	**4** Correct Volt Ohm Meter Reading	**5** Action
1-1	System Okay	---	---	---	None required
2-1	**Right Front** Solenoid valve (IV or OV) failure in modulator, wiring harness or inside ECU	15 pin	IV 5 and 3 OV 4 and 3	---	Check electrical resistance of affected valve wiring to ground at ECU vehicle connector and at modulator plug. Check voltages at wiring harness and connectors. Voltage of ground connector should be approximately 0 volts. Make necessary repairs.
2-2	**Left Front** Solenoid valve (IV or OV) failure in modulator, wiring harness or inside ECU	15 pin	IV 2 and 3 OV 1 and 3	Inlet valve: 6.5 ± 0.5 ohms Outlet Valve 3.5 ± 0.5 ohms	
2-3	**Right Rear** Solenoid valve (IV or OV) failure in modulator, wiring harness or inside ECU	15 pin	IV 1 and 3 OV 10 and 3		
2-4	**Left Rear** Solenoid valve (IV or OV) failure in modulator, wiring harness or inside ECU	15 pin	IV 8 and 3 OV 7 and 3		
2-7	Reference to ground interrupted	15 pin	3 to chassis ground		Check ABS ground connectors. Make necessary repairs.

Table 3—D Version Hydraulic ABS Blink Codes

Ignition Key On to determine ABS blink code fault		Ignition Key off to test system (except where noted)			
1	**2**	**3**		**4**	**5**
Fault Code	**Problem Area**	**Connector**	**Pins to be Tested**	**Correct Volt Ohm Meter Reading**	**Action**
3-1	Right Front sensor—Air gap	9-pin	4 and 5	Greater than 0.2 volts AC at 30 rpm (Rotate wheel ½ revolution per second)	Check for sensor adjustment. Check for excessive wheel bearing endplay. Repair or replace as needed.
3-2	Left Front sensor—Air gap	9-pin	1 and 2		
3-3	Right Rear sensor—Air gap	9-pin	3 and 6		
3-4	Left Rear sensor—Air gap	9-pin	7 and 8		
4-1	Right Front sensor—Electrical fault	9-pin	4 and 5	500-2000 ohms	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair or replace as needed.
4-2	Left Front sensor—Electrical fault	9-pin	1 and 2		
4-3	Right Rear sensor—Electrical fault	9-pin	3 and 6		
4-4	Left Rear sensor—Electrical fault	9-pin	7 and 8		
5-1	Right Front wheel—Erratic wheel speed	---	---	---	Check for tire size mismatch or tooth wheel difference. Check sensor, sensor cable, and connector for intermittent contact. Repair or replace as needed.
5-2	Left Front wheel—Erratic wheel speed				
5-3	Right Rear wheel—Erratic wheel speed				
5-4	Left Rear wheel—Erratic wheel speed				
7-3	Retarder Relay	---	---	---	Verify proper connections to relay. (see wiring diagram).
7-4	ABS Warning Lamp	---	---	--	Check bulb. Repair or replace as needed.

Table 3—D Version Hydraulic ABS Blink Codes (continued)

Ignition Key On to determine ABS blink code fault		Ignition Key off to test system (except where noted)			
1	2	3		4	5
Fault Code	**Problem Area**	**Connector**	**Pins to be Tested**	**Correct Volt Ohm Meter Reading**	**Action**
7-7	Recalculation pump does not switch off. OR Recirculation pump does not switch on (low level with act.)	18-pin	8 and 12 8 and 12	0 volt Turn Ignition on 12 volts DC	Check the recirculation pump wiring, the pump relay, fuse and pump connections. Repair or replace as needed.
7-8	Recirculating pump motor locked.	18-pin	Link pins 2 and 8	Turn Ignition on	Excessive current failure. If pump does not run when pins are linked, replace modulator assembly.
8-1	No voltage	18-pin	1 and 2	Turn Ignition on 12 volts DC	Check the valve relay, fuse, and wiring. Repair or replace as needed.
8-2	Continuous supply to ECU with ignition off.	18-pin	5 and 12	0 volt	Check for proper wiring connections. Make necessary repairs.
8-3	Internal ECU fault	---	---	---	Replaced ECU

Table 3—D Version Hydraulic ABS Blink Codes (continued)

Testing the System

WARNING

TO PREVENT SERIOUS EYE INJURY, ALWAYS WEAR EYE PROTECTION WHEN PERFORMING VEHICLE MAINTENANCE OR SERVICE.

EXHAUST GAS CONTAINS POISON. WHEN TESTING A VEHICLE WITH THE ENGINE RUNNING, TEST IN A WELL-VENTILATED AREA.

TO AVOID SERIOUS PERSONAL INJURY, KEEP AWAY, AND KEEP TEST EQUIPMENT AWAY, FROM ALL MOVING OR HOT ENGINE PARTS.

- Reference and observe the vehicle manufacturer's Warning, Cautions, and Service Procedures.
- When testing, set the parking brake and place the gear selector in **NEUTRAL** (manual transmission) or **PARK** (automatic transmission) unless otherwise directed.

Test Equipment Volt-Ohm Meter (VOM)

Use of a VOM with automatic polarity sensing is recommended. This eliminates the concern of the polarity of the meter leads during voltage measurements.

System Requirements and Component Tests

- Tire Size Range

For proper hydraulic ABS operation, front and rear tire sizes must be within 16% of each other.

Contact the Meritor WABCO Customer Support Center at (800) 535-5560 if you plan a tire size difference of more than 8%.

Calculate the tire size with the following equation:

$$\% \text{ Difference} = \left\{ \frac{\text{RPM Steer}}{\text{RPM Drive}} - 1 \right\} \times 100$$

RPM = Tire Revolutions Per Mile

Caution

When troubleshooting or testing the ABS system, do not damage the connector terminals.

Voltage Check

Voltage must be between 9.5 and 14 volts for the 12 volt hydraulic ABS to function properly.

- To check voltage

1. Turn ignition on.
2. Check for proper voltage between pins (12 and 1) and (12 and 2) on the 18 pin connector.
3. If voltage is not between 9.5 and 14 volts, verify proper wiring connections. Make corrections as required.

ABS Indicator

If the ABS indicator lamp does not come on after the ignition is turned on, or it comes on but does not go out after 3 seconds, check all ABS fuses or circuit breakers and replace.

Check the wiring to the ABS diagnostic switch and the indicator lamp. Repair, or replace the wiring as required.

- When checking the indicator lamp

1. Check voltage potential at the lamp socket.
2. Check continuity of the wires to the socket.
3. Replace bulb.

ABS Diagnostic Switch

- When testing the ABS diagnostic switch

1. Check the resistance between the terminals while cycling the switch.
2. Check the continuity of the wires to the switch (pins 5 and 12) and (6 and 12) on the 18 pin connector.

Sensor Adjustment

Caution

Do not pry or push sensors with sharp objects.

Note

Sensor will self-adjust during wheel rotation.
No gap is allowed at installation. During normal operation, a gap not exceeding 0.04 inch is allowable.

To adjust the sensor, push the sensor in until it contacts the tooth wheel.

Sensor Output Voltage Test

- Sensor output voltage must be at least 0.2 volts AC at 30 rpm. Test the sensor output voltage.

1. Turn ignition off.
2. Disconnect the ECU. Measure voltage at the pins on the ECU connector, disconnect the sensor from the sensor extension cable.
3. Put blocks under the front and rear tires to keep the vehicle from moving.

WARNING

CHOCK THE WHEELS TO PREVENT THE VEHICLE FROM MOVING. SUPPORT THE VEHICLE WITH SAFETY STANDS. DO NOT WORK UNDER A VEHICLE SUPPORTED ONLY BY JACKS.

4. Raise the vehicle off the ground. Put safety stands under the axle.
5. Rotate wheel by hand at 30 rpm (1/2 revolution per second).
6. Measure the voltage at the pins, see Table 4—Sensor Check Pins.

Sensor Resistance

- The sensor circuit resistance must be between 500 and 2000 ohms. Measure resistance at the sensor connector, or at the pins on the ECU connector.

7. Turn ignition off.

- To measure resistance at the pins on ECU connector, disconnect the ECU from the sensor extension cable.
- To measure resistance at the sensor connector, disconnect the sensor from the sensor extension cable.

8. Measure output at the pins, see Table 4—Sensor Check Pins.

Sensor	Pins (9 pin Connector)
Left Front	1 and 2
Right Front	4 and 5
Left Rear	7 and 8
Right Rear	3 and 6

Table 4—Sensor Check Pins

- If measurement is not between 500 and 2000 ohms, replace the sensor.

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